



MISSOURI DEPARTMENT OF NATURAL RESOURCES

Warm-Season, Native Grasses on Reclaimed Minelands - Landowner Management Guide

Fact Sheet

8/2000

Division of Environmental Quality
Land Reclamation Program

Reclamation with warm-season, native grasses (WSNGs) greatly improves soil quality and overall revegetation success if established and managed correctly. Improper seeding techniques and poor management have resulted in poor stands, giving many the perception that WSNGs are too expensive, too demanding and too slow to establish effective erosion control. If seeded and managed correctly, WSNGs are unsurpassed on minelands for wildlife habitat, forage quality and erosion control. Their tolerance for droughty, acid, low fertility soils make them very important plants for abandoned mine land (AML) reclamation.

WSNGs are adapted to droughty soils with high acidity, low nutrient levels and low organic matter levels. Abandoned mine lands typically possess these soil conditions due to low levels of organic matter. Warm-season, native grasses and forbs have evolved coarse, deep-growing, extensive root systems that form symbiotic relationships with mycorrhizal fungi to increase uptake of water and nutrients, especially phosphorus. Warm-season, native grasses and forbs are physiologically adapted to Missouri's occasional severe droughts. WSNGs ameliorate the harsh soil conditions of mine lands, building biological systems that promote nutrient cycling. WSNGs create excellent wildlife habitat and can play a major role in restoring threatened or endangered prairie species like the northern harrier, upland sandpiper and prairie chicken. Native grasses can also play a major role in protecting and enhancing quail and turkey habitat.

Warm-Season, Native Grasses

Warm-season, native grasses achieve maximum growth and development during the warmest months of the year, from June to mid-September. Native grasses have evolved with Missouri's volatile weather conditions, enabling them to survive cold, saturated soils in winter, and hot, dry soils in summer. Their root systems are extensive and massive, growing deeply into the soil to obtain water and nutrients during summer drought. Most of the grass biomass is below ground in their root systems. It is this enormous root system that generates the dark color of organic-rich prairie soils. Warm-season, native grasses improve compacted, nutrient-poor minespoils by the action of their extensive root systems. Roots grow into cracks, widening them and allowing water and air to enter into the minespoil. Roots comprise the organic matter that improves nutrient-holding capacity and promotes beneficial soil organisms.

Organic matter plays an important role in soil development. Organic carbon, nitrogen and phosphorus are essential for all living organisms. Mine soils are usually low in organic matter, nitrogen and phosphorus and may have a high clay content. Enriching reclaimed mine soils with organic matter accelerates soil system development. Research has determined that the amount of organic matter in the upper four inches of tallgrass prairie sod was 2.5 to 4.5 tons by dry weight per acre. This amount of organic matter in mine soils greatly increases microbial activity and nutrient cycling.

PUB002082



Important native grasses used in reclamation

Big Bluestem

Big bluestem has been called the “king of the prairie.” Prior to cultivation, big bluestem was the ecologically dominant species throughout the midwestern tallgrass prairies, maintaining itself for centuries. Big bluestem will ultimately dominate warm-season grass stands on reclamation sites. Big bluestem has been relatively easy to establish on mine sites with proper planting techniques. It is fast growing, with an extensive root system, and spreads by means of underground stems called rhizomes. Rhizomes in native prairies enable grasses to store carbohydrate reserves and function as a “life preserver” for the plant during extreme environmental stress. Big bluestem is high in nutrition and cattle eat it before most other grasses. Its great size, up to seven or eight feet on reclamation sites, give big bluestem a competitive advantage over other prairie plants and provides a high quantity and quality of forage. Although big bluestem leafiness increases with light grazing, excessive early grazing decreases the growth of rhizomes and shoots, reduces the extent of the plant’s radial spread and therefore reduces the number of shoots for the following spring. Big bluestem should not be cut after August 1 or grazed after September 1, leaving a minimum of 12 inches of stubble to restore carbohydrate reserves. Overgrazing or late haying can quickly weaken or destroy big bluestem stands by removing carbohydrate reserves. Big bluestem provides excellent nesting, resting and escape cover for small animals and birds, making it a preferred plant for wildlife habitat. Big bluestem is an attractive plant throughout the year. The stems turn various colors, from wine red to purple, and patterns, from striations to solids. The beautiful fall colors rival the brilliant reds, oranges and browns of hardwood trees. It also is known as “turkey foot,” an allusion to the seed head’s resemblance to a turkey’s three-toed foot.

Indiangrass

Indiangrass is a tallgrass prairie pioneer that quickly establishes itself by seed and provides excellent forage and vegetative habitat for wildlife and for erosion control. Indiangrass gradually gives way to big bluestem in warm-season grass stands and native prairies, except in areas of disturbance. Areas disturbed by hot, killing fires and floods that destroy the prairie sod are quickly colonized in by indiangrass. Eventually, big bluestem out-competes indiangrass on the prairie and in warm-season grass stands. Indiangrass has been relatively easy to establish on mine sites with proper planting techniques. Indiangrass grows to seven feet tall and can be distinguished from big bluestem by its lighter green color and the attractive, golden lance-like seed head. Like big bluestem, indiangrass turns beautiful colors in the fall, making a wonderful contrast to the golden seedheads. The soft, ripe seed is easily stripped by hand for next season’s planting. Indiangrass is an excellent wildlife species.

Eastern Gamagrass

Eastern gamagrass is a native, warm-season, perennial tallgrass that is adapted to mesic and hydric soils. It tolerates saturated soil conditions and was formerly found in single species stands on such sites. Gamagrass grows and spreads from coarse rhizomes into clumps of one to four feet in diameter, attaining heights of five to nine feet. The foliage is abundant and highly nutritious. Cattle grazed out most native stands in settlement times. Gamagrass is an excellent wildlife grass for overwintering, nesting and escape cover. It greens up in May and matures in June, several months before most WSNGs, yet remains palatable throughout the summer and into the fall.

This close relative of maize can be established with a corn planter. It is important to purchase high quality seed from a reputable dealer. Gamagrass seed in nature is slow to germinate due to its hard, impermeable seed coat. The large seeds must be cold-treated to force germination in the spring. Otherwise, unstratified dormant seed must be planted no later than 45 days before the last spring frost. Fall plantings of unstratified seed have been tried with little success. Some

of the large seeds are eaten by rodents; others rot in winter's saturated soils. There should be at least six to eight inches of stubble 60 days prior to the first frost to allow for regrowth and re-charge of carbohydrates that are stored in the roots for winter hardiness and early spring green-up. Haying and grazing should be restricted during this period until the first killing frost. At that point cattle can graze the dead leaves. Overgrazing or late haying in the fall can quickly and easily destroy a gamagrass stand. Burning increases seed production, promotes earlier spring green-up and reduces thatch, but fire is not required to maintain the gamagrass stand. Nitrogen fertilizer can greatly increase yields, and weeds can be controlled with herbicides labeled for use with corn. It should be noted that several of these herbicides have had negative effects on other WSNG species at the time of establishment and will kill native forbs and legumes.

Eastern gamagrass provides landowners with excellent forage and wildlife habitat, especially in WSNG mixtures. The spreading clumps are often hollow in the middle, forming a "circus top" canopy of leaves growing from the ring of rhizomes and falling into the center. This hollow center makes excellent nesting sites for ground-dwelling birds such as quail, turkeys and prairie chickens. Gamagrass also provides excellent erosion control in wet areas where few other hardy grasses will survive. It withstands dry summer conditions that kill most other wet-mesic or hydrophytic plants. **It cannot survive improper** haying or grazing management.

Little Bluestem

Little bluestem is a smaller, three-to four-foot-tall relative of big bluestem that is best adapted to harsh, droughty soils – conditions that often approximate those of reclaimed sites. Little bluestem's extensive fibrous root system is more efficient in absorbing nutrients and water than any other native grass. While its roots do not grow as deeply as big bluestem's, little bluestem's root system comprises a greater percentage by volume of the upper two feet of soil than big bluestem. Little bluestem forage is of high quality and can provide winter grazing because the dried leaves have some nutritional value. Little bluestem has shown to be extremely acid-tolerant by invading acid minespoils throughout the Midwest. Its seed is very small, thereby making it sometimes more difficult to establish than grasses with larger seeds due to the harsh soil conditions. It is common, indigenous and unique to extremely acid shale-derived soils of the West. As with big bluestem, little bluestem has brilliant wine red to purple stems and leaves in the fall, giving rise to the name bluestem. It cannot compete with big bluestem under better soil conditions but will hold its own on the droughty sites in the tallgrass prairie and on reclamation land. Little bluestem is an important wildlife species, providing cover and structural diversity.

Switchgrass

Switchgrass is quickly established and provides cover to the reclamation site. It is easily established, aggressive and will stunt the growth of big bluestem and indiangrass if the switchgrass seeding rates are too high. It will form a monoculture, which reduces wildlife habitat. In the long term, switchgrass cannot compete with big bluestem and Indiangrass once the WSNG stand is established. Switchgrass relies almost exclusively on seeds germinating in the bare mineral soil of disturbed areas, requiring full sun to mature, while big bluestem rhizomes spread into switchgrass stands, forcing out mature switchgrass and shading switchgrass seedlings. Although pure stands of switchgrass have been planted to simplify haying and grazing management, a mixed stand of WSNGs and forbs is much more effective in promoting biodiversity and enhancing wildlife habitat.

Native Prairie Legumes and Forbs

Illinois bundleflower is a highly nutritious native legume that is being developed by researchers into cultivated varieties for commercial production. For wildlife, bundleflower provides structural habitat diversity, insect food and seeds for birds such as quail and pheasants. Livestock prefer it to any other plant, including alfalfa, often grazing it out of pastures. As with most legumes, Illinois

bundleflower fixes atmospheric nitrogen, which enriches the soil. It is a pioneer species, invading disturbed areas in old fields, roadsides and prairies. Hence, Illinois bundleflower is an excellent reclamation species, adapted to harsh, dry conditions. It has been easy to establish on mine sites. Fire, broken sod, or patches of bare mineral soil are necessary to maintain self-sustaining populations.

Partridge pea, a native legume, is easily established from seed in the first season and is an important food source for wildlife. In later stages of growth, partridge pea can be unpalatable and even toxic to cattle. Its use should be limited to wildlife habitat restoration. As a legume, it fixes atmospheric nitrogen. Partridge pea is a pioneer species and, like bundleflower, is an excellent reclamation species, enduring harsh, dry conditions. It is easy to establish on mine sites. Fire, broken seed or patches of bare, mineral soil are necessary to maintain self-sustaining populations.

Included in the seeding mixture should be other native, non-grass plants, or forbs, that promote diversity and the growth and development of the reclaimed ecosystem. Plant diversity is essential to a healthy, productive system. Native sunflowers provide seed and forage to wildlife and livestock but also tap nutrients deep in the soil. Most prairie forbs are extremely deep-rooted, with roots extending beyond that of competing WSNGs near surface. Shallow-rooted plants can then tap nutrients that formerly were too deep in the soil. **Leadplant** and **prairie clovers** are native legumes that increase forage quality and wildlife carry capacity. Other forbs may be added to mixture depending upon the availability and cost of the seed and in accordance to the wishes of the landowner and the AML staff. Showy prairie forbs such as compass plant, coneflower, blazing star, rattlesnake master, maximilian sunflower, pitcher sage and coreopsis can be included in small amounts (approximately 1 ounce per acre) to add beauty and diversity.

Common lespedeza is a warm-season annual plant that can be an important source of nitrogen and wildlife food, especially for quail. Landowners and managers should not plant more than three pounds per acre in a new WSNG stand. Common lespedeza should not be planted with WSNGs in topsoiled reclamation sites or in unmined areas. Common lespedeza should be broadcast seeded under these conditions in the third year of the WSNGs stand to avoid excessive competition for soil moisture in the summer. It is extremely tolerant of drought and of poor soils with low nutrient levels. It greatly improves soil quality and provides excellent wildlife habitat. Common lespedeza is greatly prized by quail.

Do not confuse **common lespedeza** with **sericea lespedeza**. Sericea is a long-lived perennial that is overly aggressive, shading out WSNGs and tree seedlings, ultimately forming a monoculture. Livestock avoid eating it, and its importance to wildlife is minimal. Sericea inhibits natural succession. It is invasive, spreading into neighboring fields and should not be planted.

Introduced legumes like hairy vetch, birdsfoot trefoil, crownvetch, and red, white and ladino clover should not be planted with WSNGs. They are too aggressive in the crucial two-year establishment period of WSNGs. They produce large quantities of hard seed that can persist for years in the soil before germinating.

Soils and Reclamation

Typically, on reclamation sites, the soil has a naturally low fertility level and poor water-holding capacity. Much of this is due to the extremely low levels of organic matter present in newly reclaimed mine soils and from compaction caused by earth-moving equipment. Soil microbial populations and beneficial mycorrhizal fungi are low or not present. Organic matter in the form of dead leaves, stems and roots in a productive soil creates a protective mulch that reduces soil erosion and water evaporation. Organic matter acts as a sponge that absorbs and holds nutrients

and water in the soil for plant use. Decomposed organic matter, called humus, binds soil nutrients to its surface. Humus slowly releases soil nutrients that plants can use. Without humus, soil nutrients added by fertilizing are quickly leached out of the rooting zone before the plants have the opportunity to use them. Soil organic matter also feeds beneficial soil organisms that break down humus and release soil nutrients, especially nitrogen and phosphorus. Once organic matter and soil organisms are present in the mine soil, nutrients can be cycled from dead plants to humus, then from humus to living plants to begin the process again. This process is called nutrient cycling. The more organic matter that is produced, the more nutrients are stored by the humus and clay particles until an equilibrium is reached. The higher the level of nutrients that are present in the soil, the more productive the soil will be. Productivity on reclaimed mine soils is directly related to the amount of organic matter present and the amount of nutrients being cycled in the soil. Warm-season, native grasses produce huge amounts of organic matter throughout the rooting zone, promoting these beneficial soil processes in mine soils.

The movement of heavy equipment compacts reclamation soils, which inhibits root growth and reduces the soil's water-holding capacity and infiltration rate. Over time, roots and fungi penetrate the soil and increase the number and size of soil voids, or pore space. Native grasses are particularly successful at this. This action reduces soil compaction and increases the water-holding capacity of the soil. Soil organisms like earthworms burrow through the soil, further decreasing soil compaction and converting fresh organic matter into nutrients available to plants. Alternating cycles of freezing and thawing, wetting and drying, and physically breaking up the compacted soil over a period of many years. Shrinking and swelling of clay particles also contribute. These processes require time and protection from livestock and vehicles to prevent additional compaction and vegetation loss that lead to erosion. Native soils have undergone these processes for thousands of years, unlike mine soils that have been created in months or years.

Conclusion

Reclamation is a soil-building process. In natural systems, drastically disturbed lands undergo a succession of living organisms that may take decades or even centuries for successful colonization to occur. The foundation of natural succession is the development of an ecological system with the plant community being the most visible portion. However, before this plant community can be expressed, a soil biological system must be developed that creates the correct environmental conditions to allow those plants to complete their life cycles. Plants are most susceptible to harsh environmental conditions and disturbance just after germination. Many plants produce abundant seeds because most seedlings will die. The environmental changes of the micro-site that result from a developing soil biological system enable many young seedlings to survive this early establishment.

Warm-season, native grasses accelerate soil-forming processes and promote natural succession on minelands. They can grow and persist on harsh reclamation sites providing excellent wildlife habitat and forage. Their success and long-term maintenance depends upon correct establishment techniques and proper management. For more information contact the local Missouri Department of Conservation office or the Natural Resource Conservation Service Center in the area.

For more information call or write:

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